Sudbury Neutrino Observatory: Simulation of the Calibration Decay Chamber for ¹⁶N and ¹⁷N

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The energy calibration of the SNO detector will be accomplished, in part, through the use of a calibration decay chamber for ^{16}N and ^{17}N gas. A SNOMAN Monte-Carlo simulation provided a preliminary estimate of the decay chamber response. We are extending the geometry within the SNOMAN code to improve the accuracy of these simulations. Additionally, we have begun to investigate the effect of the decay chamber on the propagation of Cerenkov light in the D_2O .

Presently, the decay chamber geometry is modeled as three concentric cylinders: an outer canister, a thin shell of plastic scintillator and an interior gas volume. The actual detector has a more detailed internal structure, the most important issue being the nonconcentric location of the gas volume relative to the outer canister. The geometry is also being modified to include a photomultiplier tube (PMT) used to monitor the scintillator, the high voltage generator for the PMT, an optical coupling between the scintillator and PMT and the utility lines which provide power and supply the ^{16,17}N gas.

The decay chamber is optically opaque and potentially can screen Cerenkov light produced by 16N decays in the decay chamber from reaching the main PMT array. Using SNOMAN with our extended geometry we can estimate these screening effects by comparing simulations with the stainless steel canister replaced with a transparent media (D₂O). A comparison of the mean number of PMT hits determine the influence of the decay chamber. We will also account for gamma-ray attenuation in the stainless steel decay chamber. A first assessment will be made by reducing the thickness of the outer canister wall in the simulation so that attenuation is less than 1%. We plan further studies of the decay chamber to assess the light blocking of the decay chamber using simulated external sources of Cerenkov light, as well as using SNOMAN to track specific photon propagation paths.

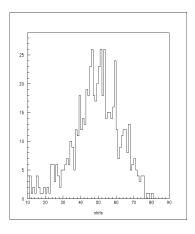


Fig. 1. Plot of PMT hits for decay chamber with stainless steel outer canister.

Footnotes and References

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